G4 Series Diode Pumped Solid State lasers

VISIBLE LASER RADIATION. AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION.
CLASS 3B LASER PRODUCT.
MAX. OUTPUT: 450mW
PULSE DURATION: CW
LASER WAVELENGTH: 532nm
MANUFACTURED BY ELFORLIGHT LTD 4B BRUNEL CLOSE NN11 8RB UK.
MODEL: G4 +100
SERIAL No: 11/22/001
DATE: JUNE 2010

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1.1. System Description

The G4 laser system consists of a laser head with a separate power supply unit which contains the drive circuits for the pump laser diode and the temperature control of the laser system. There is an interconnecting cable between the laser head which is hard wired into the laser head while having a 25 way 'D' connector for connection to the power supply unit. Please note that although the 25way 'D' connector includes circuitry to protect the pump laser diode when the laser head is disconnected from the power supply, anti-static precautions should still be observed while handling the laser head if it is not connected to the power supply.

The power supply is available in two options: 1. Fully integrated. 2.OEM supply comprising a DC supply and controller. See G4 test data for type supplied with this laser. It is possible to use an alternative D.C. supply for option 2. However, Elforlight must be consulted for advice and evaluation of the alternative supply. Failure to do so will invalidate any warranty. It is important that any power supply used is incorporates a safety earth.

The G4 laser is designed to generate laser output at 532nm. The output power level will depend on the model and it should be remembered that all G4 lasers emit laser radiation which is potentially hazardous and it is therefore strongly recommended that before operating the laser for the first time users should thoroughly familiarise with the contents of this manual. Of particular importance are the sections dealing with safe operation of the laser and general safety issues.

Please refer to separate power supply operator's manual for full details of power supply operation.

1.2. Laser Safety

This handbook contains a description of controls, adjustments and procedures for normal operation of the laser. ***CAUTION - Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.***

Classification

Elforlight G4 series lasers are classified as class 3B Lasers as defined by BS EN 60825-1:1994 and by the United States Centre for Device and Radiological Health (CDRH) 21 CFR Ch. 1 subsection 1040. This designates potential danger of eye or skin damage by exposure to direct or scattered radiation. It is recommended that all users should thoroughly familiarise themselves with these safety standards before operating the laser for the first time. It should be noted the all G4 lasers are designed as OEM sub-systems. As such they do not comply with all the requirements of BSEN 60825-1:1994 and CDRH 21 CFR Ch. 1 subsection1040. It is the user's responsibility to ensure full compliance with these standards.

Emission

The laser emits CW radiation at 532nm. Powers up to 450mWatt may be generated. The laser head also contains a laser diode emitting radiation at 808 nm within the head package. THE LASER HEAD COVER MUST NOT BE REMOVED. No customer serviceable parts are contained therein. Such access may invalidate any warranty offered by the manufacturer.

Indicators

An emission indicator on the front panel of the power supply indicates that laser emission is possible.

External interlock

The G4 series laser systems are provided with an external interlock facility. On fully cased power supplies (those with serial numbers beginning 18/10) it is provided as a socket on the front panel. For OEM supplies it is provided as an in-line link on the keyswitch cable. This connector requires contact closure to enable laser operation. The fully cased supply is provided with a shorted connector which may be incorporated into an external interlock chain if needed- eg. a room door switch or enclosure cover switch. If the interlock is broken, it is necessary to power down the laser at the keyswitch, then remake the interlock connection and commence the start sequence again to resume laser output.

1.3. Recommended Safety Precaution during Laser Operation

The laser should be used in an enclosed area with access restricted to trained personnel. The area should be clearly labelled and the entrance marked with the class of laser (Class 3B).

Only trained personnel should be allowed to use the laser.

The key must be inserted in the keyswitch and turned to enable the laser to operate. The key is captive in the operational position. As such, the key should be removed from the laser when not in use, and / or unattended, and stored in a safe place.

Eye and skin exposure to direct or scattered laser radiation is hazardous and should be considered potentially extremely harmful.

Suitable eye protection should be worn at all times whilst laser output is possible. Contact Elforlight for advice on suitable eye protection products.

The laser beam path should be terminated with a non-reflecting beam stop. Beam paths should be enclosed where possible, and should not be at eye level if practical.

Care should be taken that all mirrors and optics used are securely positioned and fixed to prevent movement. Care should be taken at all times to prevent stray reflections from surfaces in the beam path.

1.4. System Handling, Mounting and Heatsinking

It must be appreciated that any solid state laser system, especially the laser head, is a sensitive piece of scientific equipment. Whilst every effort has been made to provide a product that is rugged and reliable it is essential that the laser head is handled with care – especially when mounting. Do not drop or subject the head to impact shock such as placing it down hard on a surface.

ANY DAMAGE OR MALFUNCTION OF THE EQUIPMENT DUE TO EXCESSIVE FORCE MAY INVALIDATE ANY WARRANTY.

Mounting the laser head:

The laser head base plate is permanently attached and cannot be removed. In isolation, the plate will not provide adequate heat sinking and must be bolted to a suitable material capable of dissipating up to 15W of waste heat; we would recommend aluminium or copper. The base plate incorporates four M6 counter-bored clearance holes for this purpose. Stainless steel optical tables are not ideal and may cause overheating of the laser head leading to shutdown of the system. The use of thermal paste is also not recommended as it can act as an insulator if not correctly applied.

Elforlight will provide advice regarding correct mounting procedures and thermal transfer issues if required on request.

PLEASE BE ADVISED THAT DAMAGE OR MALFUNCTION OF THE EQUIPMENT DUE TO INADEQUATE HEATSINKING MAY INVALIDATE THE WARRANTY.

1.5. Basic Operation

The G4 and Diode Pumped Laser Systems are designed for simple, user-friendly control with the minimum of user defined parameters. All G4 lasers are designed as fixed power level devices. The power drawn from the AC mains is less than 100 VA (typically approx. 50 VA). The laser head incorporates laser diode protection circuitry and therefore the laser diode is protected even when disconnected from the laser power supply. However, Elforlight recommend the observance of full anti-static precautions during connection and disconnection of the system sub-units. Please contact Elforlight for recommended anti-static procedures.

Connections:

Integrated power supply.

Connect the laser head to the 25 way 'D' socket on the rear panel of the unit. Observe standard antistatic precautions.

Connect the supplied interlock plug to the socket on the front panel.

Connect mains input lead.

Insert key into keyswitch.

OEM power supply.

Connect the laser head to the 25 way 'D' socket on the controller.

Connect the flying lead containing the key-switch and interlock connection to the 25 way 'D' connector on the opposite side of the power supply. This interlock should be incorporated into any area or enclosure interlock system. Please contact Elforlight for advice regarding suitable interlock arrangements.

Connect the DC supply to the white six way locking connector on the power supply unit ensuring that the separate earth lead is connected to the earth stud and is securely fastened using the 'Nylock' nut supplied.

Ensure that the external interlock circuit is closed, either by use of the supplied shorted connector (temporarily for test only), or via a user supplied door or enclosure protection circuit.

The interlock connector contacts are on the keyswitch flying lead for OEM power supplies.

Operation:

The following sequences apply to both integrated and OEM power supply. The only process LED visible on the integrated supply is the Emission indicator on the front panel.

The G4 laser executes a start-up procedure during which the output power will vary. During this sequence, the front panel LED emission indicator flashes at 0.5 Hz. Only when the LED is on continuously is the power locked at specified power and the laser ready for use. Before this, lower or higher powers may be observed from the laser. The G4 laser exhibits two different start-up sequences depending on the length of time the unit has been connected to the mains supply. These may be described as:

1. **'Cold start' sequence.**
2. **'Warm start' sequence.**

1. **The cold start sequence is activated when the system has been powered down and is subsequently reconnected to the mains supply, that is, on initial start-up.**

1.1 Connect power supply to mains supply and switch ON. Insert keyswitch and turn ON.

The cold start sequence now begins with a thermal stabilisation period. From power up this phase takes a total of 4 minutes. During this period no laser output will be generated irrespective of whether the key-switch is in the 'OFF' (anticlockwise) or 'ON' (clockwise position). The keyswitch may be switched 'ON' at any time during this 4 minute period without prolonging the next stage of start-up.

After the above 4 minute 'warm up' period the supply switches automatically to an 'open loop' control mode which lasts 1 minute. During this period some laser light may or may not be emitted depending on the individual set up parameters of the laser.

After the above 1 minute 'open loop' period the laser output is ramped up from a low value to full output after which it remains in a 'power locked' mode. The total time for this power ramp is dependent upon the specific power level set. At the end of this period the Emission indicator will remain permanently on.

The warm start sequence is activated any time the key-switch is moved from the 'OFF' position to the 'ON' position provided the system has been powered up for at least 4 minutes.

The warm start sequence activates the final two periods as in 1 above; that is the 'open loop period' and the 'power ramp' period.

NOTE (1) if the system is powered down even momentarily at any time or the interlock broken, when the system is powered up subsequently the system will automatically revert to the cold start sequence.

NOTE (2) During the 'open loop' and 'power ramp' operation phase the laser output power will vary significantly from the specified output power. This behaviour is quite normal as during this period optical stabilisation is occurring.

NOTE (3) for descriptions of the mode of operation of the external interlock please refer to section 5.0 of the Laser Power Supply User Guide (included).

2. User Guide: G4 Power Supply

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1.0 Introduction

The G4 power supply is available as a single integrated supply or an OEM DC supply + controller. Both options are designed to control a laser diode and two TEC coolers. The units are micro-processor controlled and can operate a laser system or laser diode in constant current or constant power mode.

1.1 Integrated power supply

This single unit has a front and back utility panel.

The front panel contains: **1.1.1. Mains switched and fused input socket.**

1.1.2. Interlock socket.

1.1.3. Emission indicator.

1.1.4. Keyswitch.

1.1.5. RS232 port.

The rear panel contains: **1.1.6. 25 way D type connector to laser head.**

<u>Do not at any time connect or disconnect the laser head whilst the supply is powered.</u>

Apart from the basic control features already outlined, the only user interface available which may be accessed is the RS232 port. Refer to section 6.2.

1.2. OEM supply

All details are as follows in section 2.0 onwards.

2.0 Features

Compact module utilising surface mount technology

Integral heatsink or heat spreader plate

User interface (interlock, on/off keyswitch etc.)

RS232 interface

Active current limit

Active optical power limit (Ilimit cannot be exceeded)

Current or optical power feedback modes

Auto power up sequence: warmup, current mode, constant power mode

Laser diode protection circuitry

Monitor (voltage or RS232) of:

- **Current limit, current setpoint, actual current**
- **Power limit, power setpoint, actual power**
- **TEC 1 & 2 temp setpoint, actual temp**

Diode "near end of life" indicator

Diode on-time LCD hour counter (internal or optional external)

Heatsink overtemp sensor

Laser-head overtemp sensor

Status & Diagnostic LED cluster

Designed and manufactured in the U.K.

3.0 Connections: Plugs & Sockets

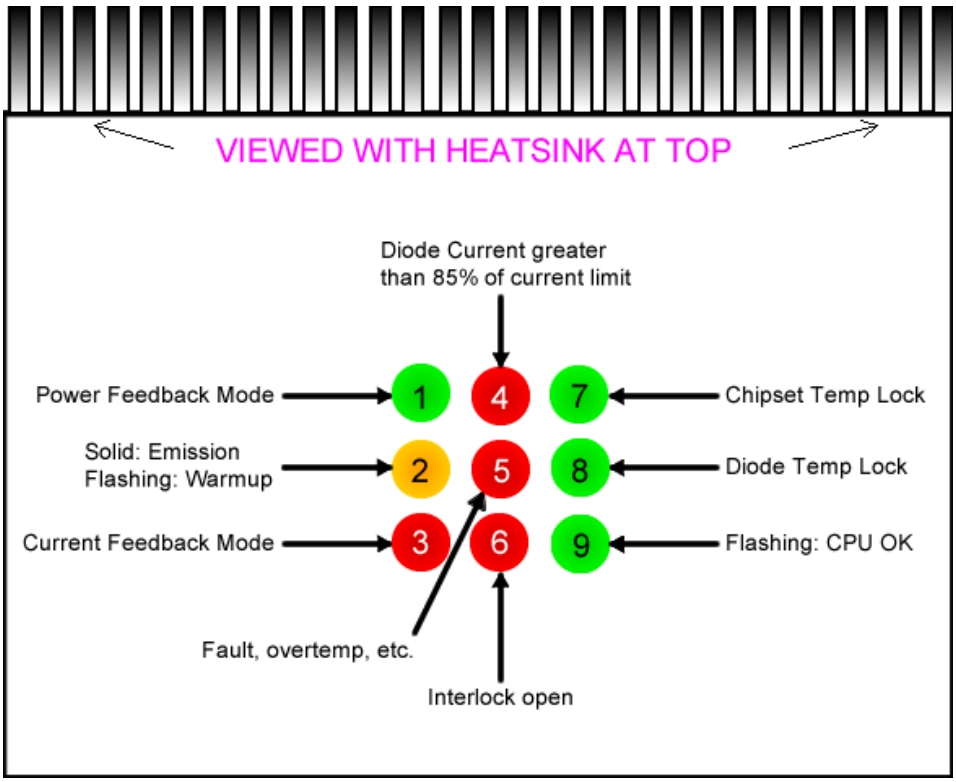
The module has a number of plugs and sockets: the laser head connector is on one end of the module and the other connectors are on the opposite end. All connectors can be secured by screws (4-40 UNC D-type) or locking barb (Molex).

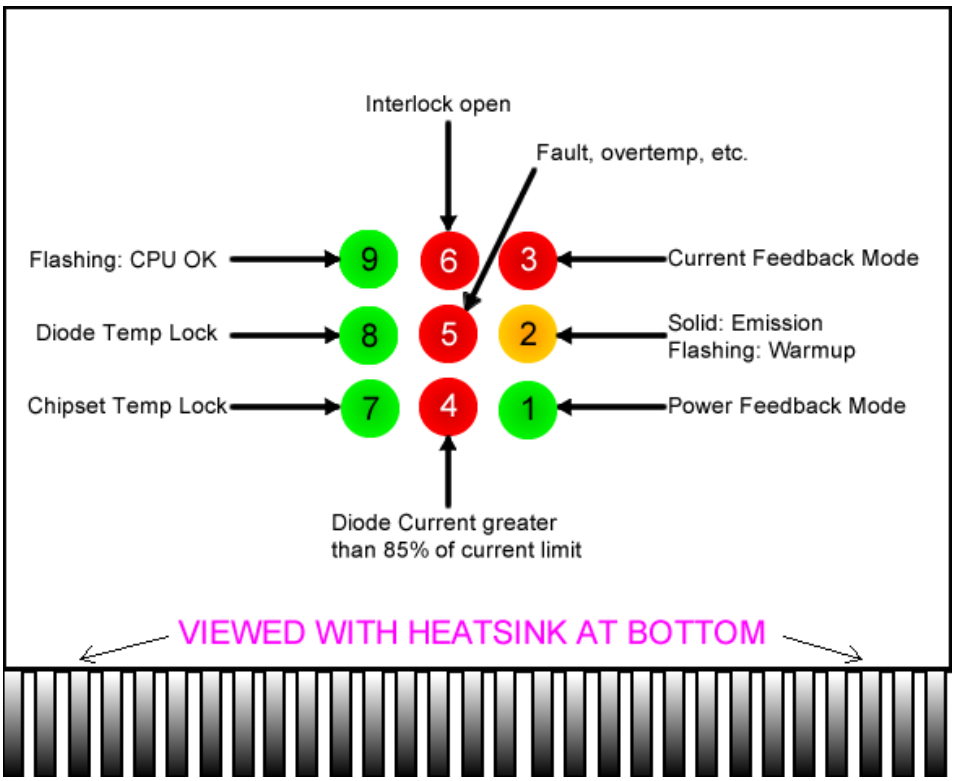
Plug No.	Function	Connector Type
PL1	User	25W D type plug
PL2	RS232	9W D type socket
PL3	Power	6W Molex
PL4	Laser Head	25W D type socket

The Molex connector is known as a "Molex MiniFit Junior"

The pin outs and function of the various connectors are described in section 6 below.

4.0 Indicator and Status LED's.





Notes

LED 9 should be flashing as soon as power is applied. If LED1 is permanently on or off, this indicates that the processor software has crashed.

LED's 7 and 8 are illuminated when TEC1 and TEC2 are within +/- 0.5'C of their respective temperature setpoints.

LED 6 is illuminated when the interlock chain is opened. This condition is latched and can only be cleared by switching the keyswitch input off and then closing the interlock chain. The laser may then be energised by closing the keyswitch input.

LED 5 is illuminated when various fault conditions exist, such as:

- **TEC1 hot/cold**
- **TEC2 hot/cold**
- **Laser head hot**
- **PSU heatsink hot**
- **PSU and laser head data do not match**

LED 4 is illuminated when the monitored diode current is > 85% of the diode current limit value. *This condition is not a fault*, but a useful indication that the laser diode may be reaching the end of its life when the laser is operating in optical feedback mode. That is, it takes more diode current to achieve a certain pre-set laser power output as the laser diode ages. Alternatively, when in power feedback mode, the diode current may be higher than normal due to non-optimised heatsinking etc. Bear in mind that high power units (>100mW) may require higher diode currents and so this LED may be lit all the time.

LED 9 is illuminated when the laser is operating in current feedback mode (e.g. during the warm-up period).

LED 2 is the laser emission indicator. This will flash when the laser is warming up in current feedback (constant diode current) mode, and be permanently on when the unit has warmed up and is operating is optical feedback (constant laser power) mode. When this LED is off, the laser diode driver is off and no current is passing through the laser diode.

LED 1 is illuminated when the laser is operating in optical feedback mode (e.g. after the warm up period has completed and the laser is giving stabilised laser output power).

5.0 Switch on/off sequence

The laser system can be operated in its simplest form by two inputs to the user connector, in the form of simple external voltage free contacts or TTL signals.

The two input signals are referred to as:

a) Interlock

b) Keyswitch

These inputs are low current TTL inputs internally pulled up to +5V with 10k ohm resistors. Therefore, if using external volt free contacts, make sure they are high quality with silver or gold plated contacts designed to switch low current TTL signals.

The interlock is typically wired in series with the users access doors etc. Again, make sure the external circuit is volt free, as damage will be caused if connected to mains voltage! If not used, it may be permanently linked out.

The keyswitch input is used to switch the laser on or off. It does not have to be a keyswitch, a good quality switch or TTL input will work. The use of a keyswitch will prevent unauthorised use of the laser. Safety issues may require the use of a keyswitch with the key only removable in the off position.

<u>Powering up "from cold"</u>

External power is off.

Interlock chain is made.

Keyswitch is off.

External power on.

Watchdog LED flashes.

Keyswitch is on.

Emission LED flashes.

After an initial warm up period of 5 minutes, the laser diode is energised in current feedback mode.

Red current mode LED is on.

After a further 1 minute warm up period, the laser is switched to optical feedback mode and the emission LED is permanently on.

Red current mode LED is off, Green optical feedback mode LED is on.

Warmed up TTL signal is asserted (active low).

At any stage the keyswitch input may be switched off to inhibit laser emission.

Breaking the interlock whilst the laser is on will cause emission to be stopped. Making the interlock again will not cause immediate emission if the keyswitch is still on. The module must detect an on-to-off-to-on transition of the keyswitch before emission will occur.

6.0 Connector Pin-Out Detail

6.1 PL1, User Connector

25 Way D type plug.

Pin No.	Function	Pin No.	Function	Pin No.	Function
1	/INTLK	10	IDEMAND	19	0V
2	/KEYSW	11	PSET	20	EXT_MOD
3	/EMM	12	DT_SP	21	/u_INTLK
4	/AT_LIMIT	13	CT_SP	22	IMON
5	RESET_HRS	14	0V	23	PMON2
6	+12V	15	0V	24	DT_MON
7	INT/~EXT	16	RPU	25	CT_MON
8	ILIMIT	17	RPU		
9	PLIMIT	18	COUNT_HRS		

/INTLK, Pin 1 (TTL input, active low)

The interlock input is internally pulled up to +5V by a 10K ohm resistor. When connected to GND (PL1, pin 14) or driven to logic low, the interlock is sensed as being OK.

/KEYSW, Pin 2 (TTL input, active low)

The keyswitch input is used to switch the laser on or off, provided that the interlock input is OK. It is internally pulled up to +5V by a 10K ohm resistor. When connected to GND (PL1, pin#15) or driven to logic low, the keyswitch is sensed as being made and laser emission will occur.

/EMM, Pin 3 (TTL output, active low)

This output is driven low when there is laser emission, i.e. laser diode current is not zero and the crowbar is off. It is asserted when yellow emission LED8 is illuminated

/AT_LIMIT, Pin 4 (TTL output, active low)

This output is pulled up to +5V by a 10K ohm resistor, and is driven low when the diode current is within 95% of its current limit. This condition is not a fault, but a useful indication that the laser diode may be reaching the end of its life when the laser is operating in optical feedback mode. That is, it takes more diode current to achieve a certain pre-set laser power output as the laser diode ages.

RESET_HRS, Pin 5 (+12V output, active high)

This output is driven high when it is required to reset the LCD hour counter to zero. This function can only be carried out by the manufacturer.

+12V, Pin 6 (Power)

This pin is connected to the +12V supply and is only intended to power an external LCD hour counter. Do not use for any other purposes, current supply is limited to 100mA.

INT/~EXT, Pin 7 (TTL input, active low)

This input has been reassigned and is driven low when the laser has warmed up and there is laser emission in optical feedback mode.

<u>Diode Current (0-5V analogue voltage output monitor)</u>

ILIMIT	**Pin 8**	**Diode current limit setpoint**
IDEMAND	**Pin 10**	**Diode current setpoint (when in current feedback mode)**
IMON	**Pin 22**	**Diode actual current**

Sensitivity 0.5V per 1.0 amp

5V corresponds to a current of 2.5 amps

<u>Laser Power (0-5V analogue voltage output monitor)</u>

PLIMIT	**Pin 9**	**Laser power limit setpoint**
PSET	**Pin 11**	**Laser power setpoint**
PMON2	**Pin 23**	**Laser power monitor**

Sensitivity T.B.D.

5V corresponds to a power of T.B.D. mW

Temperature (0-5V analogue voltage output monitor)

DT_SP	**Pin 12**	**TEC1 temperature setpoint**
DT_MON	**Pin 24**	**TEC1 actual temperature**
CT_SP	**Pin 13**	**TEC2 temperature setpoint**
CT_MON	**Pin 25**	**TEC2 actual temperature**

Sensitivity 100mV per 1.0'C

2.5V corresponds to a temperature of 25.0'C

0V, Pins 14, 15 and 19 (Power)

These pins are connected to the module's ground plane and external 0V supply. Do not connect to a known electrically noisy source.

RPU, Pin 16 & 17

330 ohm resistive pull up to +5V. If external LED's are required to be used in conjunction with the /EMM and /AT_LIMIT outputs, connect the LED anode to RPU and LED cathode to either /EMM or /At_LIMIT.

COUNT_HRS, Pin 18 (+12V output, active high)

This output is driven high whenever there is laser diode current flowing. The hour counter shows the cumulative laser diode on time in 0.1 hour increments, to a maximum of 99999.9 hours (11.4 years)

RESET_HRS, COUNT_HRS, +12V, GND.

These pins are for use with an external hour counter.

/U_INTLK, Pin 21 (TTL output, active low)

This output is the micro-processor latched interlock output. This output is internally pulled up to +5V with a 10k ohm resistor and is driven low when the external interlock input on pin 1 is open or driven logic high. This output is latched in that it will remain driven low even when the external interlock input on pin 1 is driven low again. Either power off the unit or toggle the keyswitch to the off position (if it was in the on position when the interlock chain was broken) to clear the interlock condition.

6.2 PL2, RS-232 Connector

9 way D type socket.

Pin No.	Function	Pin No.	Function
1	/SETUP	6	N.C.
2	TX	7	N.C.
3	RX	8	N.C.
4	N.C.	9	GND
5	GND		

Do not connect pin 1 to pin 9. This will cause the unit to enter RS232 control/factory setup mode and operating parameters may be changed. The laser may not then perform to specification. If using "off the shelf" or proprietary serial cables, ensure that there are no connections to pins 1 & 9 at the PC end.

If you intend to control the laser system via the RS232 interface, please contact the factory for further details and command set.

6.3 PL3, Power Connector

6 way Molex Minifit Jr.

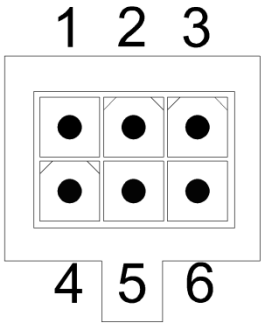
The module is energised by an external d.c. power supply, usually supplied by the manufacturer. It will be equipped with the correct leads to connect to the module and your country's A.C. mains supply.

OEM customers may wish to use their own external d.c. power supply.

Specification for the external d.c. power supply is as follows:

+5V @ 8 amps, (plus +/-12V @ 150mA if internal DC/DC converter not fitted)

Connector view looking at power supply.



Pin No.	Function	Minimum AWG
1	0V	20
2	5V	20
3	-12V	24
4	0V	20
5	5V	20
6	+12V	24

Mating free receptacles:

6 way **Molex 39-01-2 06 0**

Crimp sockets **Molex 39-00-0078 (16 AWG, wire size 1.29mm^2, 1.8-3.1mm insulation diameter)**

Molex 39-00-0039 (24-18 AWG, wire size 0.24-0.82mm^2 , 1.3-3.1mm insulation diameter)

Tooling for Molex Mini-Fit Jr.

Ratchet crimp tool **Molex 69008-0724**

Extraction tool **Molex 11-03-0044 (HT60630B)**

6.4 PL4, Laser Head Connector

25 way D type socket.

For completeness, details are given below. The user must not dismantle/modify the laser head connector as this contains electronics.

Pin No.	Function	Pin No.	Function	Pin No.	Function
1	Earth	10	TEC1-	19	For test only
2	MPD-	11	TEC1+	20	For test only
3	MPD+	12	Laser diode-	21	For test only
4	Thermistor2-	13	Laser diode+	22	For test only
5	Thermistor2+	14	GND	23	For test only
6	TEC2-	15	+5V	24	Thermistor3-
7	TEC2+	16	SDA	25	Thermistor3+
8	Thermistor1-	17	SCL		
9	Thermistor1+	18	For test only		

NEVER, UNDER ANY CIRCUMSTANCES, UNPLUG THE LASER HEAD FROM THE POWER SUPPLY WHILST THE SYSTEM IS ENERGISED BY THE EXTERNAL DC SOURCE! YOU MAY DESTROY THE LASER DIODE AND INVALIDATE YOUR WARRANTY!

Do not be tempted to "mix-and-match" different laser heads with different power supplies unless you have the interchangeable head option, available to larger volume OEM customers. If you do try to mix and match laser heads without authorisation, both the laser head and power supply will be disabled by software; it will not be possible then to produce laser emission.

It is usual for the system to be shipped with the laser head connected and secured to PL4. It is not recommended that the user disconnects the laser head from PL4 without good reason.

The laser head may only be disconnected (not recommended) from the power supply when the system is off **and** ***the external power supply is disconnected from PL3, the power connector. However, make sure the external DC power supply is switched off at the mains first. In this case the laser diode in the head will be protected by shorting circuitry even when unplugged from PL4, the laser head connector. At all times observe anti-static precautions, using wrist and heel grounding straps at a designated anti-static work station.***

7.0 RS232 Command Set.

The laser may be remotely controlled by a PC using a simple protocol.

ASCII characters (uppercase only) are sent by the PC. Characters must be sent one at a time, with a time delay between consecutive commands, so as not to overrun the serial input buffer.

7.1 Command Set.

0	**Deselect all (default)**
1	**Select Ilimit**
2	**Select Idemand**
3	**Select Plimit**
4	**Select Pdemand**
5	**Select TEC1 temp**
6	**Select TEC2 running temp**
7	**Select TEC2 standby temp**
8	**Select MPD gain channel**
+	**Increment selected parameter**
-	**Decrement selected parameter**
E	**Enable laser emission**
R	**Disable laser emission (default)**
D	**Enable TEC 1 (default)**
F	**Disable TEC 1**
C	**Enable TEC 2 (default)**
V	**Disable TEC 2**
I	**Select current feedback mode (default)**
P	**Select light feedback mode**
Z	**Zero internal hour counter**
?	**Request status**

Notes:

Ensure single character commands are in upper case only.

Serial protocol is 9600 baud, 1 start bit, 8 data bits, 1 stop bit, no parity, no handshaking.

(Default) = condition on power up.

+/- Key presses adjust the selected parameter accordingly and store the value in non-volatile memory.

Commands will only be executed if the programming link (pins 1 & 9 shorted in the 9 way D type plug) is detected on power up.

7.2 Status bytes.

Subject to change.

In response to a "?" command, the module will return a number of bytes ("0" TO "255") in decimal format, sent as printable ASCII characters "0" through "9", delimited by spaces or <CR> <LF>.

7.4 Other Protocols.

Large volume OEM users may request different protocols so that the module may be integrated into their systems. Please bear in mind that the microprocessor used has limited program/data memory so extravagant protocols (USB etc.) will not be offered. Contact the factory for further details.

8.0 Heatsinking and Orientation.

The unit is equipped as standard with a black anodised finned heatsink. If the module is to be mounted vertically, the user should ensure that the heatsink fins run vertically also. If the subsequent orientation of the connectors is not suitable, the heatsink may be rotated by 90 degrees: please contact the factory for further details.

If the module is mounted so that the heatsink is upside down, i.e. at the bottom of the module, it may be necessary for the user to provide forced air cooling from a fan etc. This is only applicable to higher power laser systems (>100mW, 532nm).

As an option, the module may be supplied without a heatsink but mounted on a metal plate. The user may then mount the module via the metal plate. However, thermal interface and heat transfer issues must be addressed by the user. Please contact the factory for further details.

9.0 Mechanical mounting.

The unit is mounted using M3 screws. M3 mounting holes are located in the heatsink or heat spreader plate. Ensure screws do not penetrate the heatsink by more than 8 mm.

10.0 Specification.

Diode driver:

Maximum current	2.5 amps
Noise/Ripple	<1.0% rms
Compliance	4 volts
Ilimit adjustment	0-2.5 amps in 256 steps, 9.76mA increments.
Idemand adjustment	0-Ilimit, 256 steps, Ilimit/256 increments.
Feedback mode	Current or optical power

Dual TEC/Peltier driver:

Maximum current	+/- 4 amps
Compliance	4 volts

Bi-directional current control using MOSFET 'H' bridge

Temperature sensor	10k ohm @ 25'C NTC thermistor
TEC1 temp range	15-35'C
TEC2 temp range	15-40'C

Over temperature protection

Control via hardware (TTL inputs) or software (RS232)
RS232: 1 start, 8 data, 1 stop bits, 9600 baud, no handshaking, no Xon/Xoff, 3 wire interface, RxD, TxD and ground
LCD hour counter, up to 99999.9 hours, 0.1 hour (6 minute) resolution, non-volatile, factory resettable.

External D.C. power supply:
+5V DC +/-3% @ 8 A (Optional +/- 12V DC @ 150mA)
Load regulation +/-0.5%, Line regulation +/-0.3%
Ripple & Noise 65mV (1.3%)

Heatsink

Cooling	Convection or force air cooled
Material	Extruded aluminium
Finish	Black anodised

If mounting heatsink vertically, orientate such that fins are vertical also.
Various heatsink options available, including heat spreader plate: contact factory.

Enclosure

Material	Aluminium 1mm sheet
Finish	Clear anodised

Weight PSU 300g, Heatsink 255g

Dimensions PSU 112mm x 106mm x 45mm excluding heatsink
Heatsink 150mm x 105mm x 16mm

11.0 Approvals

The unit has been tested to, and complies with:
EN61326:1998 calling EN55011:1991 GROUP 1 CLASS B
BS EN61000-3-2:1995 + AMMENDMENTS 1,2 & 3.

The unit is suitable to be "CE" marked.

The unit has been tested to be immune from radio emissions produced by mobile telephones, at the specific frequencies of 900MHz and 1.8GHz and a field strength of $3Vm^{-1}$. However, it is advised that mobile telecommunications equipment should not be used within 1 metre of the laser system.

12.0 Flash/PAT Testing of external DC Power supply

The external DC power supply has been flash/hi-pot tested by the OEM. It is strongly advised not to repeat this procedure which may result in insulation break down. Flash testing the unit when connected to the laser controller and laser head may cause damage to the laser diode.

The external DC power supply may be tested by a PAT tester, for earth continuity, insulation, run current and run leakage current. Do not perform these tests with the laser controller and laser head attached, and do not perform the flash test if the PAT tester supports this.